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I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003907214 for a patent by ARVID MURRAY JOHNSON as filed on 05 December 2003.

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WITNESS my hand this
Eighth day of July 2004

J. Billingsley

JULIE BILLINGSLEY
<u>TEAM LEADER EXAMINATION</u>
<u>SUPPORT AND SALES</u>

ROTATORY CRANKSHAFT

.This invention relates to an apparatus which produces
.a mechanical conversion from or between rotary and linear
.or non -rotary mechanical motion.
.(subject matter)
.
.Hitherto such conversions have been applied by a range of
.mechanical an electro-mechanical devices, which are not
.as suitable for some applications in mechanical and
.nautical engineering.

.Prior Art (Details: Refer to Appendix 4 - Prior Art and
. Rebuttals of Prior Art in Contention)
.List:
.the Common Single and Double crankshaft,
.the James Watt Sunwheel crankshaft, the Cog and rachet
.wheel crankshaft, the Scotch Yoke crankshaft, the Bell
.crank, the epicycloidal crank.
. Nautical Steering Systems:
.the quadrant and pinion, the hydraulic piston and arm,
.the travelling screw and arm (electric).

.
. Steering systems: worm gear and quadrant, worm gear
. and worm gear sector, worm and nut, worm and worm-
. gear sector (connected to approximately linear drag link).
.(prior art)

. ---

.The object of this invention is to produce a
.conversion from rotary to linear or non-rotary motion or
.vice-versa , which is superior for some purposes.
.(objects)

. ---

.According to this invention a diskus rotary crankshaft
.apparatus consists of:
.(A). a frame which houses the apparatus and to which
.components are attached rigidly or non -rigidly with
.appropriate constraints of motion.

.

.(B). a shaft which can rotate about its axis when driven by
.mechanical or electromechanical means and which
.incorporates a cam or an equivalent crank pin shaft.
.The cam can in the limit be circular as with an eccentric
.or shaped to apply the force more surely and exactly
.to the surface if forces are large or the tolerances
.are large and make the point of contact given by a circle

.

.insufficiently precise.

.

.

.(C). a ‘quoit’-disk, or ‘connecting disk’ , denoted ‘kondiskus’ ., which is engaged to the main shaft via the cam surface .and the ‘quoit’-bearing or inner bearing of the kondiskus. .This outer disk is free to rotate independently about the .inner cam like a ‘quoit’ .

.

.(D). a conrod and yoke with a bearing which is engaged to .the ‘quoit’ disk or outer disk at the yoke-bearing.

.

.(E). a guide bar or slot to assist in the support of the .yoke.

.

.(F).a slot or cylinder to guide and support the end of the .conrod.

.

.(G).a configuration in which the mainshaft center of .rotation is on a line perpendicular to the kondiskus line of .linear motion or line of reciprocation through the .kondiskus center or virtual center (the assymmetric

.

.configuration) .

.

.(F). a configuration in which the mainshaft center of
.rotation is on a line which is the condiskus line of linear
.motion (the symmetric configuration) .
.(statement of invention/consistory)

. ---

. A rotatory crankshaft constructed in accordance with the
.invention will be described by way of example only, with
.reference to drawings Figures 1, 2 , 3 and 4 .

.

.The frame is made to support the apparatus and main-
.shaft bearings and mechanical connections and
.control connections. Ref. Figure 1, G1 , G2 and Figure 4.

.

.The mainshaft (MS1) is supported on bearings attached
.to the frame . Ref. Figure 4
.The mainshaft torque can drive the conrod via the cam and
.condiskus or the conrod force can drive the mains shaft
.except at two neutral points. An appropriate periodic
.force and flywheel or mass is required. In , eg. nautical
.stearing applications , the motion is slow and intermittent

.and a flywheel is not required.

.

.In the symmetric configuration the stroke and return
.stroke are symmetric. Ref. Figure 3
.In the assymmetric configuration the stroke and the return
.stroke are not symmetric. Ref. Figures 1 and 2.
.The dimensions and ratios of dimensions are not fixed
.but, must vary within limits. The cam must rotate
.within the limits of the Kondiskus.
.The surfaces G1 and G2 , Figure 1 , are constraints
.which produce a linear sliding motion. If the application
.required it , they could also move through an angle
.thus modifying , but not preventing motion.

.

.

. Addendum 1. The Centers C_0 and C_1 and C_2 must <u>not</u>
.be the same .
. Addendum 2. The outer Connecting Disk (Kondiskus)
.does not rotate through a full circle . It rotates sectorally
.and oscillatorally .
. Addendum 3. The extreme rotation of the sector is not
.exactly the same as the extreme displacement of the

.conrod (experimental observation) .

. Addendum 4. Other intermediate states between the
. Symmetric and extreme Assymmetric are possible by
. selection of other centers on the 'Circle of Centers'.
. (Figure 4 – Circle of Centers)
.(specific description)

– – –

.The Claims defining the invention are as follows :

.Claim 1.

. This type of Rotatory crankshaft consists of :

.(A) a main shaft and cam or inner disk which is supported
.on bearings and can rotate in a circular motion carrying the
.cam with it.

.

.(B) an outer disk , denoted 'kondiskus' , in which the main
.shaft and cam rotate within an inner or 'quoit' bearing.

.(C) a yoke and yoke bearing within which the outer
.disk or 'kondiskus' can rotate to the extent of the motion
. produced by the mainshaft and cam.

.(D) a conrod attached to the yoke . The conrod moves
.with a stroke and return stroke ,which can be symmetric
.or assymmetric depending on the configuration of the
.centers of the main shaft, cam, and kondiskus.

.(E) A restraint on the conrod head directing its motion,
.usually linearly. An additional constraint , or slide guide
.on the sides of the yoke if large forces are encountered.

.

.Claim 2.
.The two configurations possible and the range of
.dimensions of the cam and the range of locations of the
.centers make it possible to design a wide range of
.strokes and motions of the conrod head.

.Claim 3.
.The property of producing linear reciprocation of the
.conrod means the a piston pin is not required in many
.applications . In a horizontally opposed engine two piston
.pins are not required .

.

.Claim 4.

.The structure of the yoke and disks can be made to be .immensely strong. The conrod can be solidly attached to . or cast or forged or machined as part of the yoke and the .piston or other driving mechanism. This is an advantage .with nautical stearing systems as the rudder can be .subject to very large forces and also weigh many tons .

APPENDICES

\- - -

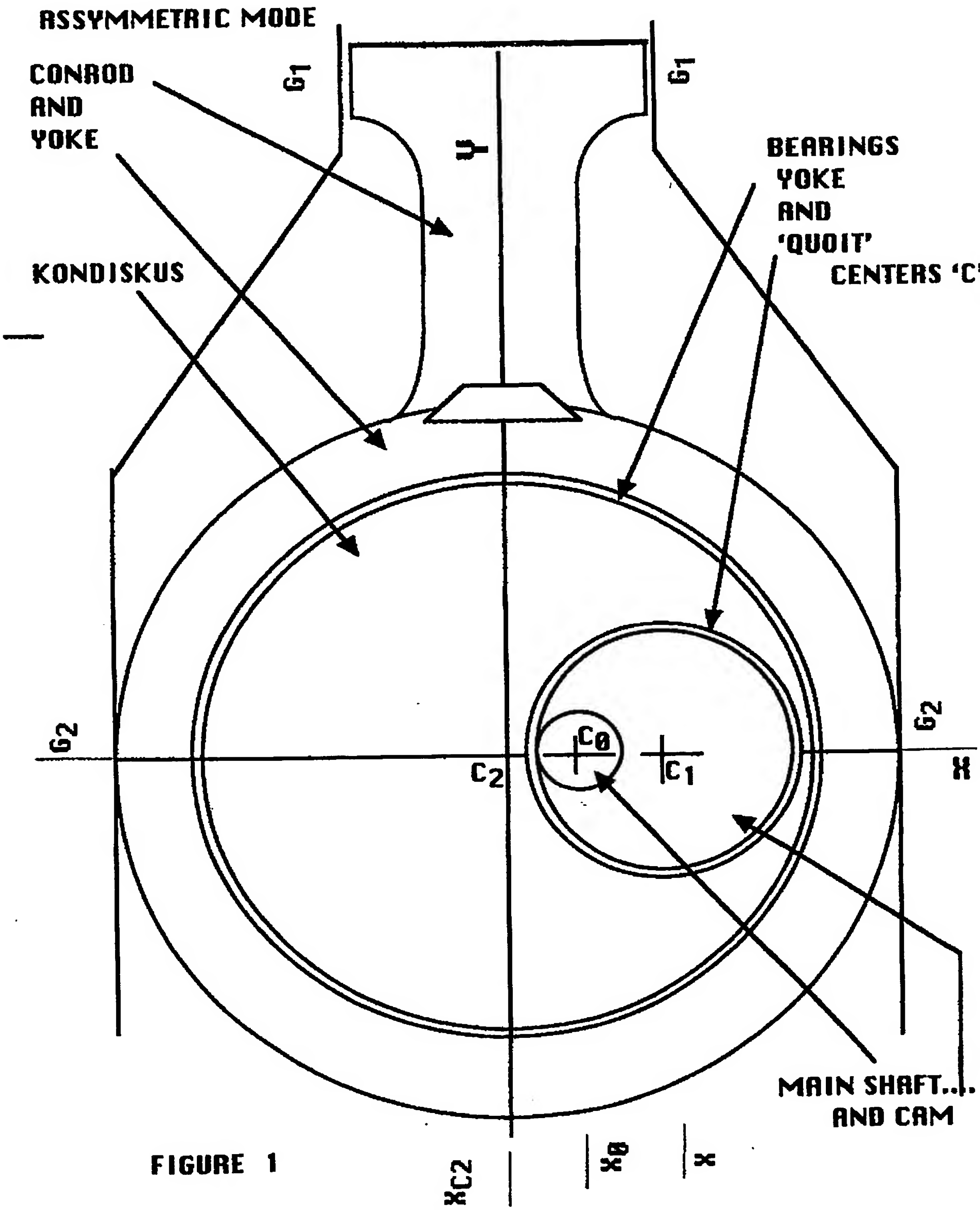

ASSYMMETRIC MODE
CONROD
AND
YOKE
KONDISKUS
BEARINGS
YOKE
AND
'QUOIT'
CENTERS 'C'
G1
G1
Y
G2
G2
X
C0
C1
C2
MAIN SHAFT....
AND CAM
XC2
X0
X

FIGURE 1

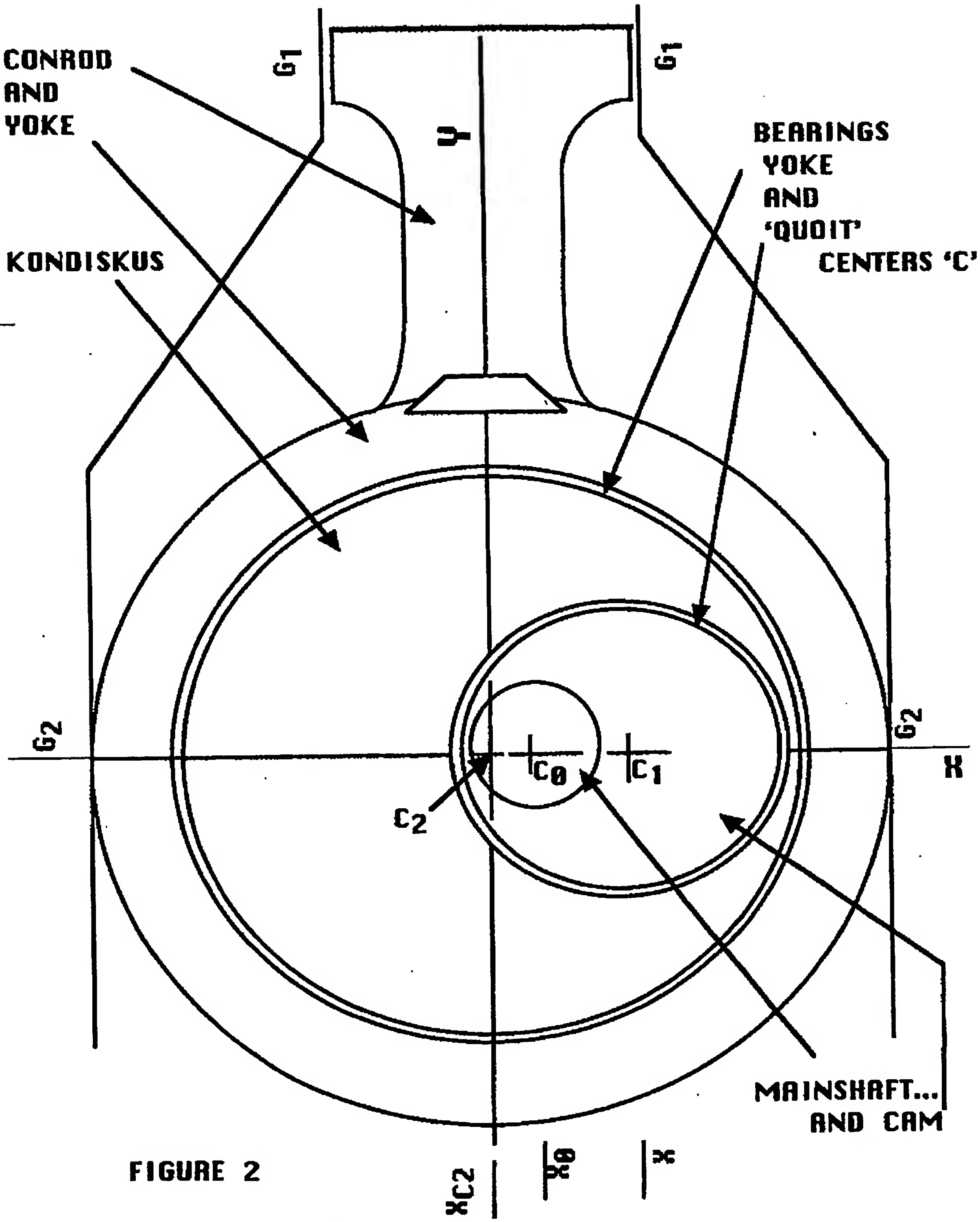

CONROD
AND
YOKE
G1
G1
Y
BEARINGS
YOKE
AND
'QUOIT'
CENTERS 'C'
KONDISKUS
G2
G2
X
C0
C1
C2
MAINSHAFT...
AND CAM
XC2
X0
X

FIGURE 2

PATENT SPECIFICATION

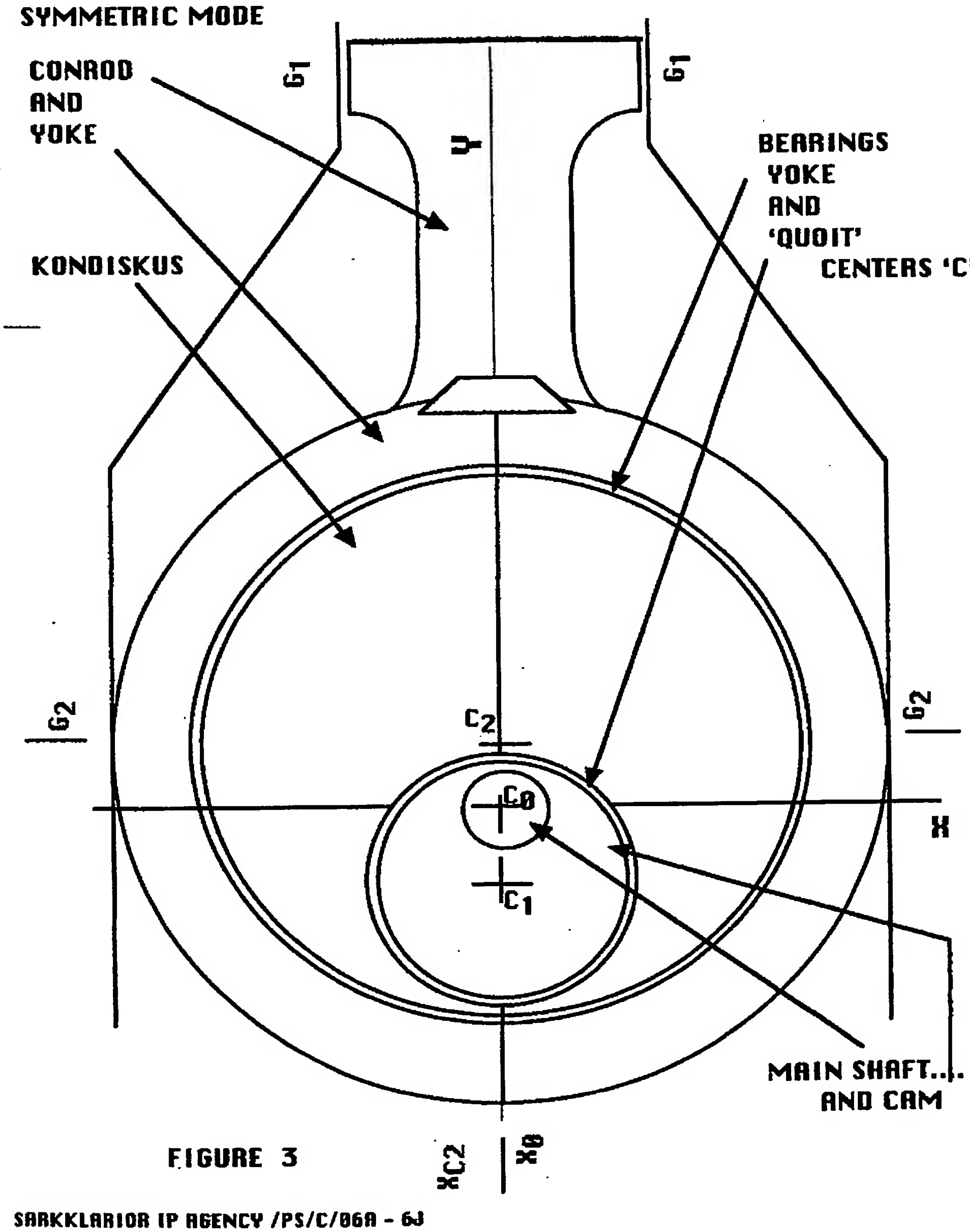


FIGURE 3

PATENT SPECIFICATION

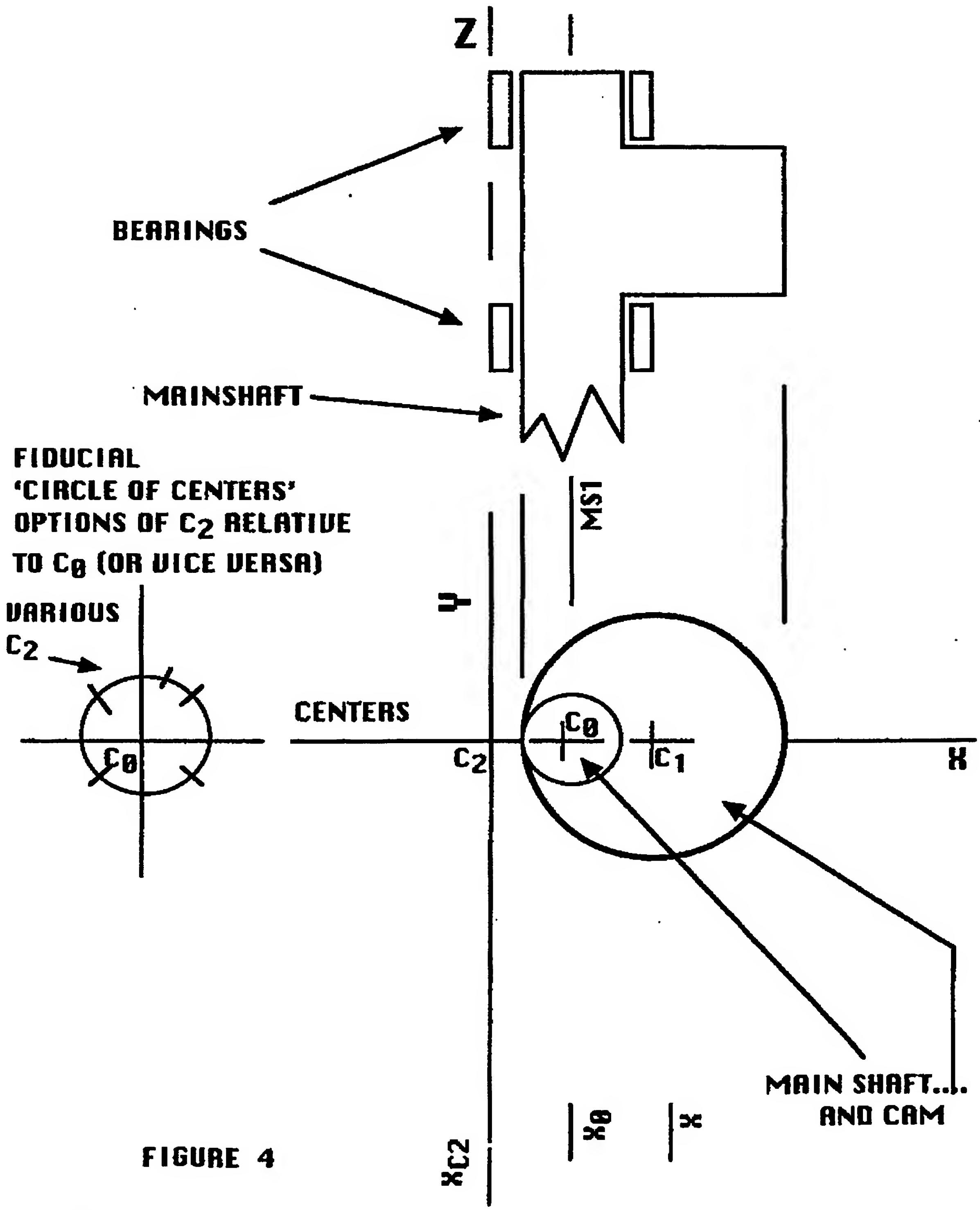
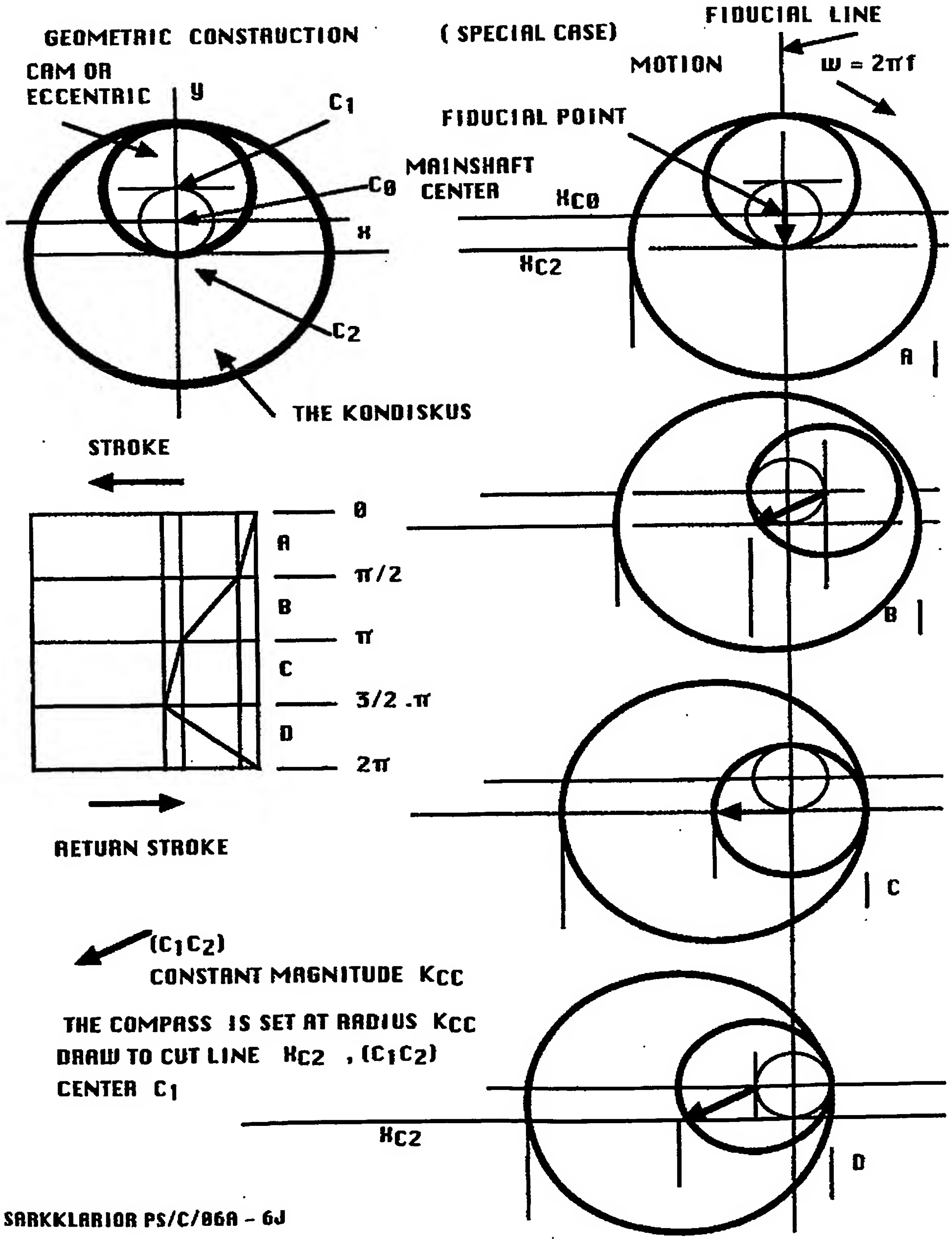


FIGURE 4

APPENDIX 1


GEOMETRIC CONSTRUCTION
(SPECIAL CASE)
FIDUCIAL LINE
MOTION
ω = 2πf
CAM OR
ECCENTRIC
y
C1
FIDUCIAL POINT
MAINSHAFT
CENTER
C0
XC0
x
XC2
C2
A
THE KONDISKUS
STROKE
0
A
π/2
B
π
C
3/2 .π
D
2π
B
RETURN STROKE
C
(C1C2)
CONSTANT MAGNITUDE KCC
THE COMPASS IS SET AT RADIUS KCC
DRAW TO CUT LINE XC2 , (C1C2)
CENTER C1
XC2
D

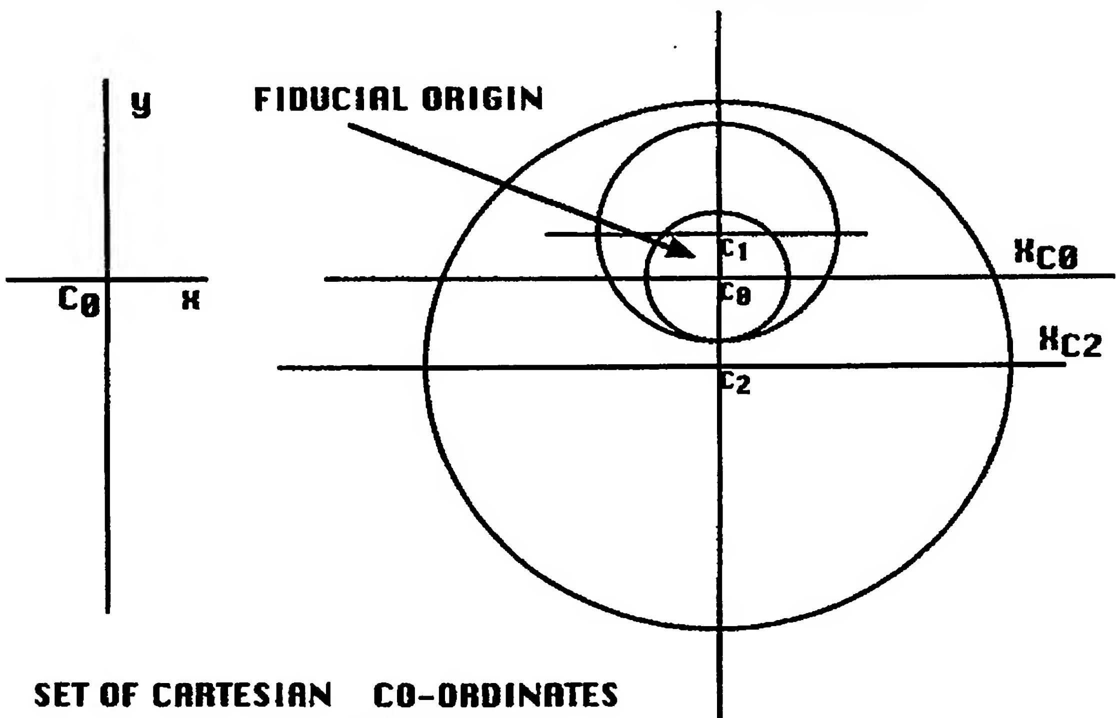
APPENDIX 2

VECTOR ANALYSIS

$A\underline{\underline{a}} = (C_{\underline{0}}\, C_{\underline{1}})$
$B\underline{\underline{b}} = (C_{\underline{1}}\, C_{\underline{2}})$
$C\underline{\underline{c}} = (C_{\underline{0}}\, C_{\underline{2}})$

$\underline{\underline{a}}$ is a unit vector
$(C_{\underline{0}}\, C_{\underline{2}})$ is a vector

DIAGRAM A2/1



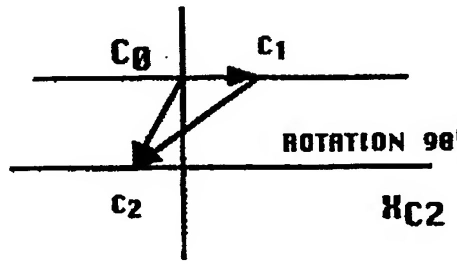
SET OF CARTESIAN CO-ORDINATES
ORIGIN C_0

THE MAGNITUDE OF VECTOR $(C_1C_2) = K_{12}$ A CONSTANT
IT IS A NON-LOCALISED VECTOR. (REF.2 , PP 11, 62)
THIS CORRESPONDS WITH THE KONDISKUS , WHICH HAS TWO DEGREES OF

FREEDOM IN THIS CASE, EXCEPT THAT THE CENTER C_2 IS CONSTRAINED TO THE LINE OF MOTION X_{C2}, IN THIS CASE, (BUT NOT NECESSARILY IN ALL CASES).

$C\underline{c} = A\underline{a} + B\underline{b}$

DIAGRAM A2/2



$\underline{a} = x_1 i + y_1 j + z_1 k$ CARTESIAN ijk UNIT VECTORS

$\underline{b} = x_2 i + y_2 j + z_2 k$

NOW IF THERE IS NO MOTION ALONG THE MAIN SHAFT AXIS DIRECTION, (IT COULD OCCUR), THEN $z_1 = 0$ $z_2 = 0$

$\underline{a} = x_1 i + y_1 j$ initial $x_1 = 0$, $y_1 = y_{10}$, (C_0C_1)

$\underline{b} = x_2 i + y_2 j$ inilal $x_2 = 0$, $y_2 = (C_1C_2)$

$(C_1C_2) = (C_0C_1) + (-)(C_0C_2)$

$y_{12} = (-)y_{01} + y_{02}$

UNLOCALISED.

THE VECTOR $\underline{a}$, ROTATES ABOUT C_0, ωt IS CLOCKWISE (ANGLE OF ROTATION, θ IS ANTICLOCKWISE.

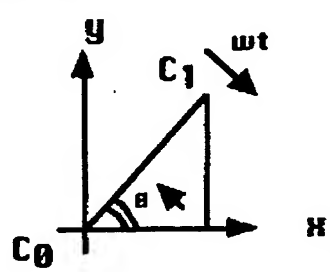


DIAGRAM A2/3

$x_1 = x_{10} \cos(\pi/2 - \omega t)$ $y_1 = y_{10} \sin(\pi/2 - \omega t)$

IN THE FIRST QUARTER $\omega t = (-)\pi/2$,SO , $x_1 = x_{10}$ AND $y_1 = 0$

[2] $x_{10} = y_{10} = /C_0C_1/$ WHICH IS A RADIUS VECTOR

ANGULAR FREQUENCY $\omega = 2\pi f$ FREQUENCY OF MAINSHAFT f

$$\underline{a} = (x_{0a} \cos(\pi/2 - \omega t))\, i + (y_{0a} \sin(\pi/2 - \omega t))\, j$$

$$f_{1i}(x_0,t) \qquad + f_{1j}(y_0,t)$$

THE CO-ORDINATE TO BE DETERMINED IS THE CO-ORDINATE x_3, WHICH IS THE CO-ORDINATE OF THE " KONDISKUS CENTER C_2 ", ON THE LINE X_{C2} .

$$\underline{b} = \underline{c} - \underline{a}$$

$$\underline{c} = x_3\, i + y_3\, j$$

NOW y_3 IS CONSTANT IN THIS CASE AND PROBABLY IN MOST APPLICATIONS. THE LINE X_{C2} COULD BE VARIED DURING THE MOTION. ROTATORY AVIATION ENGINES EG THE B.R.1 AVIATION ENGINE HAD CYLINDERS WHICH ROTATED (REF.1 VOL1 PAGE 61).

$$\underline{a} = f_{1i}(x_0,t)\, i + f_{1j}(y_0,t)\, j$$

$$\underline{c} = x_3\, i + K_{cj}\, j \qquad y_3 = K_{cj} \quad \text{CONSTANT}$$

$$\underline{b} = \underline{c} - \underline{a} \qquad \text{VECTOR } \underline{b} \text{ IS NON-LOCALISED}$$

SO

$$\underline{b} = (x_3 - f_{1i}(x_0,t))\, i + (K_{cj} - f_{1j}(y_0,t))\, j$$

NOW $\underline{b} = C_1 C_2$ WHICH IS OF CONSTANT MAGNITUDE K_{CC}

$$/\underline{b}/^2 = (K_{CC})^2$$

$$= (x_3 - f_{1i}(x_0,t))^2 + (K_{cj} - f_{1j}(y_0,t))^2$$

$$= [x_3^2 - 2\, x_3\, f_{1i}(x_0,t) + f_{1i}(x_0,t)^2]$$

$$+ [K_{cj}^2 - 2\, K_{cj}\, f_{1j}(x_0,t) + f_{1j}(y_0,t)^2]$$

[2]

AS A QUADRATIC

$$
\begin{aligned}
\{\ & x_3^2 \\
& - 2\ x_3\ f_{1i}(x_0,t) \\
& + [\ f_{1i}(x_0,t)^2 \quad K_{cj}^2 - 2\ K_{cj}\ f_{1j}(y_0,t) + f_{1j}(y_0,t)^2\ ] \\
& - (K_{CC})^2 \qquad \}
\end{aligned}
$$

$$= 0$$

EQUATION V1

EQUATION V1 IS SOLUABLE FOT A GIVEN TIME t. IT GIVES THE DISPLACEMENT x_3, ALONG LINE X_{C2}. IT IS ASSUMED THAT THE LINE X_{C2}, IS CONSTANT. IT COULD VARY, EG +/- 20^0, WITHOUT IMPEDING THE MOTION, ALTHOUGH IT WOULD ALTER THE PATH OF MOTION. IN MOST PRACTICAL APPLICATIONS X_{C2} IS A CONSTANT DIRECTION LINE.

THE PHYSICAL FORMULA, EQUATION V2, GIVES THE DESIGNER OF A MOTION $f(x,t)$, GREAT SCOPE TO SELECT CONSTANTS TO OPTIMISE THE MOTION FOR THE PROPOSED PARTICULAR APPLICATION.

REF.1 AUTOMOBILE ENGINEERING VOL.1 P61 6 VOLUMES
AMERICAN TECHNICAL SOCIETY
CHICAGO 1922, COPYRIGHT 1909....1922

"THE ROTARY FORM MUCH RESEMBLES THE FIXED RADIAL, THE DIFFERENCE BEING MERELY IN THE VALVE-OPERATING MECHANISM ,IGNITION GEARING, AND THE LIKE, DUE PROVISION BEING MADE FOR THESE TO FUNCTION AS THE CYLINDERS ROTATE ".

REF.2 ELEMENTARY VECTOR ANALYSIS PP 11,62 LOCALISED VECTORS
C. E. WEATHERBURN
LONDON G. BELL & SONS LTD, COPYRIGHT 1921 ....1953, REVISED 1955

APPENDIX 3

. THERMODYNAMIC CONSIDERATIONS

.The crankshaft can be applied to thermodynamic systems
.eg steam engines , refrigerators and internal combustion
.engines . This is one but not the sole application of the device
. Quote REF.2 VOL.1 , P 67
." , All automobiles in this country, England, and many other
.foreign countries, are rated by means of the formula which
.was originated by the Royal Automobile Club of England,
. adopted by the Association of Licensed Aotomobile
.Manufacturers, then by its successor, the National
.Automobile Chamber of Commerce, and, finally, by the
.society of Automobile Engineers. Its form is

. $$h.p. = D^2 N / 2.5$$

.in which D is the bore of the cylinders, N the number of
.cylinders, and 2.5 a constant worked out from tests on a
.number of automobile engines. In other words, to find the
.rating horsepower of a motor, square its bore, multiple by
.the number of cylinders, and divide by 2.5 .
. The formula can be simplified to the following form :

. $$h.p. = D^2 N * 0.4$$

that is, the square of the bore times the number of cylinders- times 0.4 will give the S.A.E. rating. It must be remembered that the result obtained from this formula is the horsepower developed at a piston speed of 1,000 feet per minute. Suppose a motor has a stroke of 5 inches; the piston would then travel 10 inches, or 10/12 foot, in one revolution of the crank shaft. In order to travel 1,000 feet, it would be necessary to operate at a speed found by dividing 1.000 by 10/12, which is 1200 r.p.m. If the motor had a stroke of 6 inches, the piston would travel 1 foot in one revolution. The rating would then be at 1,000 r.p.m. " Unquote.

COMMENT This physical formula has constraints in its formulation and application, and it is within those limitations that it is used, herein, for illustrative purpose.

The point to be observed, is, that the piston speed is significant factor in determining S.A.E. horsepower rating. Two otherwise identical motors, have different strokes and therefore different piston speeds at the same crankshaft speed of revolution. Importantly, the motor with the faster piston speed has, at the standard piston speed of 1,000 feet

.per revolution, the same S.A.E. power at 1,000 r.p.m. as the
.motor with the slower piston speed has at 1200 r.p.m.

. The device described in this specification , gives the
.engine designer the option of using the assymmetric mode
.of the device to increase piston speed without increasing
.the speed of revolution of the crankshaft.

.The thermodynamic implications would depend on the
.specific design , eg the fuel used, the use of a
.turbocharger .

.The S.A.E. formula, does not apply to diesel engines, steam
.engines or refrigerators. The factor of piston speed is of
.thermodynamic significance in these systems.

.

APPENDIX 4

PRIOR ART AND REBUTTALS OF PRIOR ART IN CONTENTION

4.1 PRELIMINARY DEFINITIONS OF TERMS AND NOTATION

4.11 IDENTITY OF DEVICES ANALYSED

4.111 APPLICANTS DEVICE

PROVISIONAL PATENT No. 2003903244 ROTATORY CRANKSHAFT

SHORTLY REFERRED TO AS D*/PAKEN

4.112 UNITED STATES PATENT No. 5,664,464

DATE OF PATENT SEPT 9 1997

DOUGLAS TIMOTHY CARSON

D/CARS

4.113 UNITED STATES PATENT No. 4,411,16

DATE OF PATENT OCT 25, 1983

PETER DURENEC AND AUBREY J. DUNN

ASSIGNEE – THE UNITED STATES OF AMERICA AS REPRESENTED BY THE SECRETARY OF THE ARMY, WASHINGTON DC

D/DU & DU

4.114 INTERNATIONAL PUBLICATION No. WO 95/13414

INTERNATIONAL PUBLICATION DATE 18 MAY 1995

GALVIN , GEORGE FREDERIC

D/GALV

4.115 DEUTSCHES PATENTAMT PATENT No. DE 4445131A1
DATE OF PATENT 27 - 6 - 96
LIEBICH MAX (DR)

D/LIEB

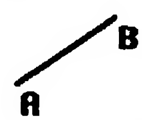
4.116 INTERNATIONAL PUBLICATION No. WO 00/08325
INTERNATIONAL PUBLICATION DATE 17 FEB 2000
OZDAMAR HASAN BASRI

D/OZDA

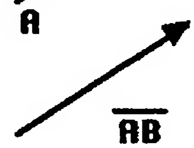
4.12 NOTATION THE VECTOR ANALYSIS (GEOMETRIC) IS SIMPLIFIED TO VECTORS IN ONE PLANE AS THE DEVICES DESCRIBED, HEREIN, CAN BE DESCRIBED, MOSTLY, BY VECTORS IN ONE PLANE. THIS FACILITATES THE GEOMETRIC CONSTRUCTION OF VECTOR DIAGRAMS.

4.121 THE VECTOR (FORCE AND VECTOR LENGTH)

THE VECTOR IS REPRESENTED BY A LINE - $\overline{AB}$

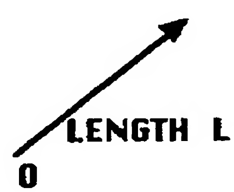


THE FORCE VECTOR IS REPESENTED BY AND ARROWHEAD WHICH GIVES THE VECTOR DIRECTION



THE VECTOR LENGTH IS REPRESENTED BY THE LENGTH OF THE LINE AND THE ARROWHEAD GIVES THE VECTOR DIRECTION. THE VECTOR MAY CORRESPOND TO A PHYSICAL LINKAGE.

IF IT IS A 'LOCALIZED VECTOR' ,THAT IS, THE VECTOR IS FIXED AT THE POINT '0' , THEN THE POINT IS LABELLED '0' , THE ORIGIN. IN THE DYNAMIC DEVICES THERE IS USUALLY ONLY ONE ORIGIN EG. THE MAIN SHAFT



VECTOR LINKAGE - THE ARROW ALSO REPRESENTS AN 'EQUIVALENT VECTOR LINKAGE' TO THE COMPONENT IN THE DEVICE, BUT IS IN GENERAL NOT A PHYSICAL ROD LINKAGE ITSELF.

4.122 LOCALIZED AND UNLOCALIZED VECTORS

THE 'LOCALIZED VECTOR' WHICH HAS ONE END AS A FIXED POINT, CANNOT MOVE OTHER THAN ABOUT THE FIXED POINT AS A "ROTATIVE VECTOR' OR CHANGE ITS MAGNITUDE,THE FIXED ORIGIN 'O' BEING UNALTERED.

THE 'NON-LOCALIZED VECTOR' CAN MOVE ANYWHERE IN THE VECTOR PLANE SUBJECT TO THE 'CONSTRAINTS' IMPOSED BY LINKAGES OR EQUIVALENT LINKAGES AND MECHANISMS DEVISED AS PART OF THE INVENTIVE OR DESIGN PROCESS.

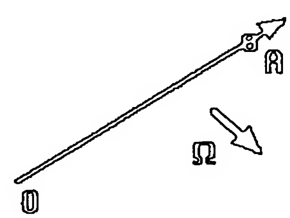
4.123 THE TORQUE VECTOR (TORQUE AND DISPLACEMENT)

THE TORQUE VECTOR IS REPRESENTED IN THE X-Y PLANE BY AN ARROW VECTOR WITH A SMALL CIRCLE BEHIND THE ARROWHEAD. THE NOTATION SIMPLIFIES THE REPRESENTATION OF TORQUE. THE TORQUE IS ALWAYS IN THE DIRECTION OF THE Z AXIS PERPENDICULAR TO THE X-Y PLANE. IT IS, HEREIN ONLY, ALWAYS A LOCALIZED VECTOR ROTATIVE ABOUT A FIXED ORIGIN 'O'.

THE ANGULAR VELOCITY IS SHOWN BY Ω AND A SHORT ARROW

IF OA IS THE 'LENGTH A', THEN TORQUE L GIVES

A FORCE 'F' PERPENDICULAR TO OA AT POINT 'A'



L = F x A , A IS 0.1 METER,

L IS 20 NEWTON-METER

F = 20/0.1 = 200 NEWTON APPLIED AT "A"

THIS NOTATION IS ADAQUATE FOR CRANK PINS, ECCENTRICS AND CAMS.

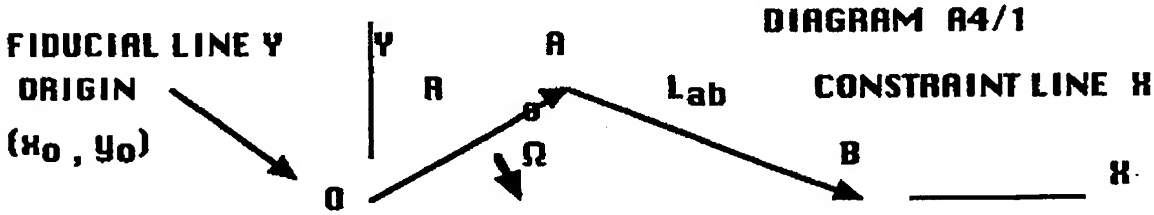
4.124 DRIVER AND DRIVEN COMPONENTS

THE DEVICE, USUALLY, IS REVERSIBLE IN ITS DIRECTION OF PRIMARY FORCE. E.G., A CRANKSHAFT MAY DRIVE A PISTON TO START AN ENGINE AND THEN THE PISTON DRIVES THE CRANKSHAFT, INTERMITTENTLY. THE REVERSAL OF THE DIRECTION OF FORCE MAY BE INDICATED BY A NEGATIVE SIGN (-) OR (NEG VECTOR) OR BY REVERSAL OF THE DIRECTION OF THE ARROW- HEAD .

4.125 EXAMPLE - THE COMMON DOUBLE CRANK SHAFT

VECTOR ANALYSIS

DIAGRAM A4/1



MAIN CRANKSHAFT CENTER- 'O', ALSO FIXED POINT OF LOCALIZED VECTOR, ALSO ORIGIN OF CARTESIAN SET OF COORDINATES

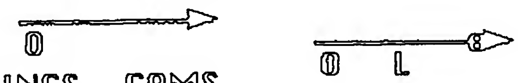
CRANK LINK PIN- 'A', RADIUS OF ROTATION 'R', CONROD LENGTH L_{ab}

PISTON LINK PIN - 'B' LINEAR CONSTRAINT PROVIDED BY PISTON WALLS

A GRAPH OF 'PISTON DISPLACEMENT' V_s 'ROTATION ANGLE' CAN BE CONSTRUCTED. LINE OX IS THE 'LINE OF RECIPROCATION'.

4.126 VECTOR CLASSES OF DEVICES – CLASSES OF MECHANISM

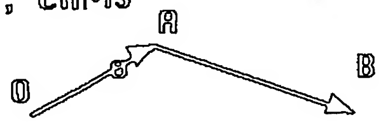
CLASS 1 UNIVECTOR DEVICES



NOTE L CAN BE VARIABLE EG SPRINGS, CAMS

CLASS 2 TWO VECTOR DEVICES

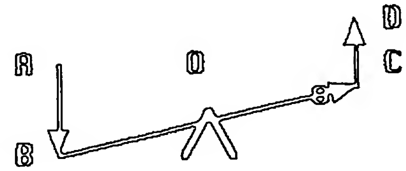
EG THE COMMON DOUBLE CRANK AND



CONROD. CONSTRAINT OF PISTON PIN TO AXIAL DIRECTION 'X'

CLASS 3 THREE VECTOR DEVICES

EG A SEE-SAW

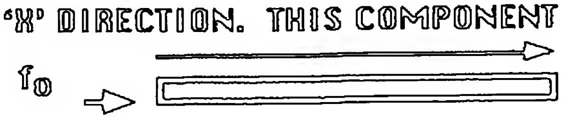


4.126 THE PRINCIPLE OF EQUIVALENT REDUCTION OF A SET OF VECTORS

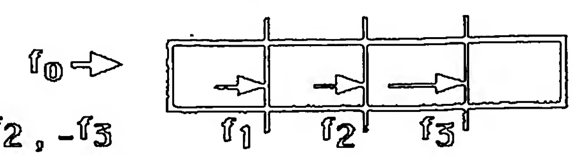
THIS MATTER IS ONLY CONSIDERED AS IT IS IMPORTANT IN THE VECTOR CLASSIFICATION OF ONE OF THE DEVICES ANALYSED HEREIN. THE ARGUMENT WILL BE USED, BUT NOT EXCLUSIVELY, THAT IF TWO DEVICE BELONG TO TWO DIFFERENT VECTOR CLASSES, THEN THE DEVICES ARE, ON THIS POINT ALONE, SUBSTANTIALLY DIFFERENT.

EG, A VALVE LIFT CAM, A UNIVECTOR CLASS OF DEVICE, IS DIFFERENT TO A BELL CRANK, A THREE VECTOR CLASS OF DEVICE.

CONSIDER A SOLID BLOCK OF METAL, WITH A FORCE APPLIED AT ONE END, WHICH IS FREE TO MOVE IN THE 'X' DIRECTION. THIS COMPONENT IS DESCRIBED BY ONE VECTOR.



SUPPOSE THAT THE METAL BLOCK IS CUT AT THE PLANE BY A STRAIGHT CUT OR BY A CURVED CUT, PERFECTLY NORMAL TO THE PLANE.



REACTION FORCES ARE $-f_1$, $-f_2$, $-f_3$

ONE WOULD NOT CLASSIFY THIS AS A 4 VECTOR CLASS OF DEVICE. PROVIDED THAT THE FORCES ARE NORMAL TO THE SURFACES AND THAT NO DIRECTIONAL CHANGES OCCUR THEN THIS SET OF FORCES IS REDUCIBLE TO ONE FORCE f_0 , AS ORIGINALLY.

EVEN IF THE INTERFACES SLIDE RELATIVE TO EACH OTHER DUE TO SOME OTHER FORCE, THE EQUIVALENT REDUCTION IS STILL VALID, IF THE ACTION OF THE FORCE IS UNALTERED.

VECTORS - COMPARISON OF DEVICES (DIFFERENTIA)

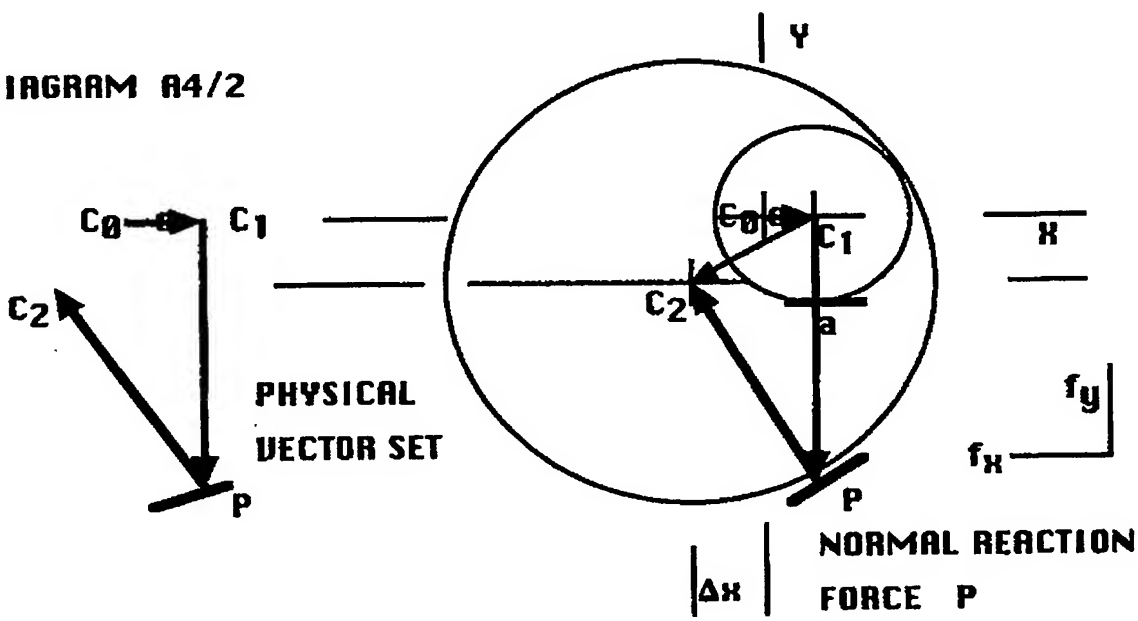
1. FIDUCIAL VECTOR CONFIGURATION
2. VECTOR CENTERS
3. VECTOR ROTATIONS
4. VECTOR CLASS
5. VECTOR DYNAMIC MOTION

4.2 VECTOR ANALYSIS

4.21 DEVICE D*/PAKEN

THE DEVICE IS CLASSIFIED AS THREE VECTOR DEVICE, PHYSICALLY. THE MOTION CAN BE ANALYSED USING A 'REDUCED SET OF VECTORS' OF TWO VECTORS. THE PHYSICAL PATHS OF THE VECTORS IS CONSIDERED BECAUSE THIS DEVICE D*/PAKEN AND DEVICE D/CARS HAVE COMPLEX VECTOR SYSTEMS AND COMPLEX VECTOR DIFFERENCES.

DIAGRAM A4/2



THE LOCALIZED VECTOR C_0C_1, ROTATES THROUGH A CIRCULAR CYCLE ABOUT FIXED POINT C_0, (X_0, Y_0). THE MAIN SHAFT TORQUE ABOUT CENTER C_0 GIVES A NON-LOCALIZED VECTOR FORCE WHICH IS NORNAL TO THE BEARING SURFACE AT POINT 'a', AND IS TRANSMITTED TO THE BEARING SURFACE AT POINT 'P'. THE NORMAL REACTION IS THROUGH THE CENTER C_2. IT IS <u>IMPORTANT TO NOTE</u> THAT THE REACTION VECTOR HAS CHANGED DIRECTION.

THE REDUCED VECTOR SET, WHICH IS THE MINIMUM REQUIRED, COMBINED WITH PATH AND BOUNDARY CONSTRAINTS, TO DESCRIBE THE DYNAMIC MOTION OF THE DEVICE IS OBTAINED BY VECTOR ADDITION.

$$\overline{C_1P} + \overline{PC_2} = \overline{C_1C_2}$$

THIS CREATES A COMPLEX SITUATION WHEN COMPARISONS ARE MADE BETWEEN DEVICES.

THIS IS A THREE VECTOR DEVICE, PHYSICALLY, AND A TWO VECTOR DEVICE AS A REDUCED SET , TO PLOT THE MOTION PATHWAY.

THE 'SECTORAL' MOTION

THE MOTION OF THE 'YOKE' DISK (OR THE DISC IN THE YOKE BEARING OR THE "KONDISKUS) IS A 'SECTORAL MOTION" NOT A CIRCULAR OR FULL CIRCLE MOTION.

THE SECTORAL MOTION OCCURS IN BOTH THE SYMMETRIC AND ASSYMETRIC MODES

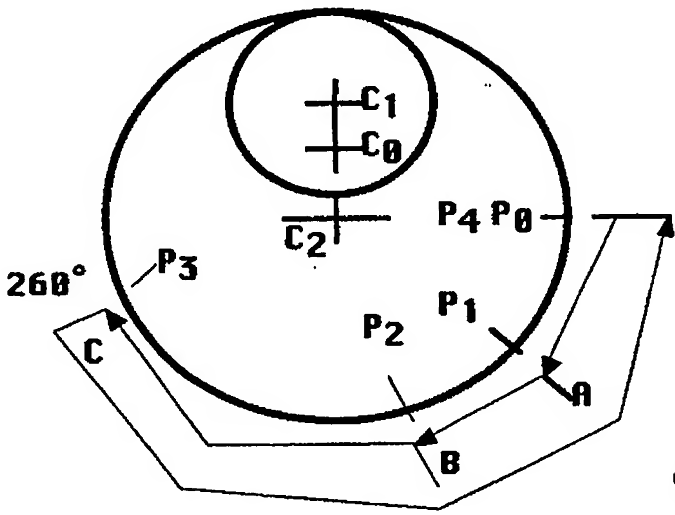
EXPERIMENTAL OBSERVATION

TYPICAL DIMENSIONS WERE USED EXPERIMENTALLY. THE CENTERS C_0 , C_1 , CAN BE VARIED WIDELY AND INDEPENDENTLY, PROVIDED THAT, THE RELATIONSHIP ,INITIALLY, C_2 , C_0 , C_1 , IS MAINTAINED.

NOTE : DURING THE FULL CIRCLE ROTATION OF THE MAINSHAFT THE CENTER C_1 , PASSES BETWEEN THE CENTERS C_0 AND C_2 .

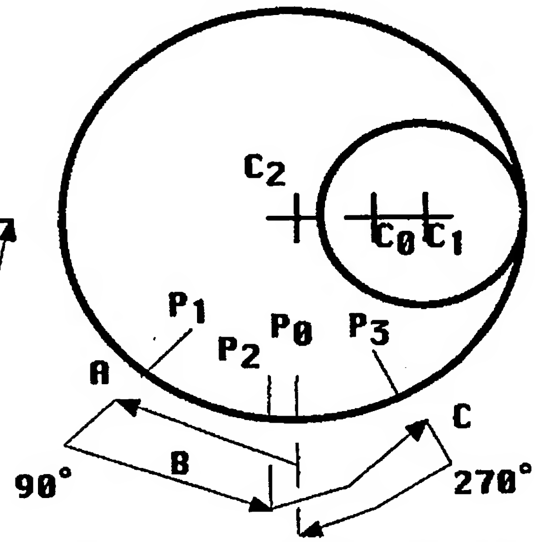
NOTE: THE CENTER C_0 , AT POINTS ON 'CIRCLE OF MAINSHAFT CENTER OPTIONS' .

ASSYMETRIC



SECTORAL MOTION (APPROX 170°)

SYMMETRIC



SECTORAL MOTION (APPROX 90°)

MAINSHAFT ROTATION C_0C_1 0°, 90°, 180°, 270°.

DIAGRAM A4/3

4.22 DEVICE D/CARS

THIS DEVICE CONSISTS, IN PART, OF CRANK JOURNALS 32A AND 32B, AND A CRANK PIN 34, (P7,LINE 51) WHICH ENGAGES AND ROTATES ON HOLE 46 (P8, LINE 27) AND THE HOLE IN CAM 40 (P8, LINE 29). THE HOLE 46 HAS BEARING SURFACES THAT INCLUDE THE CYLINDRICAL PORTION OF CAM 40 (P7, LINE 67)(P8, LINE 1). IN FIG 2 TO FIG 8, THE CAM (CYLINDRICAL PORTION) ROTATES FREELY ABOUT CRANK PIN 34. THE CAM (CYLINDRICAL PORTION) IS FREE TO ROTATE IN BEARINGS 28A AND 28B (P7, LINE 63-64). THIS BEARING IS RIGIDLY ATTACHED TO THE CONROD 22 (FIG 1) .

NOTE: NO COMMENT WILL BE MADE ABOUT THE OTHER COMPONENTS OR FUNCTIONS.

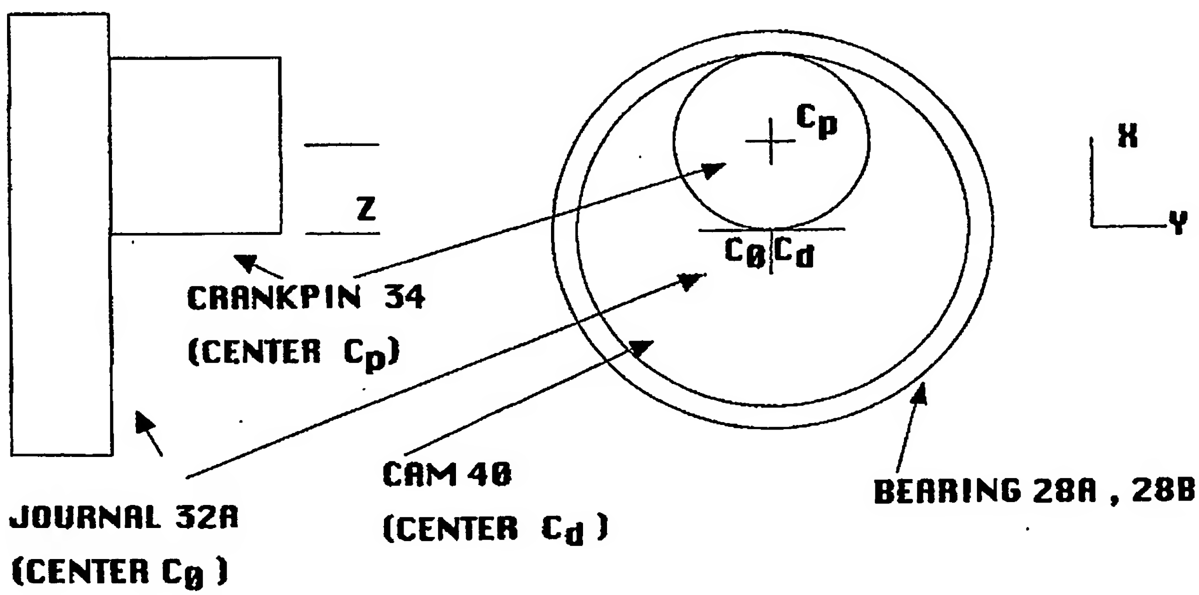
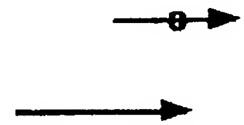


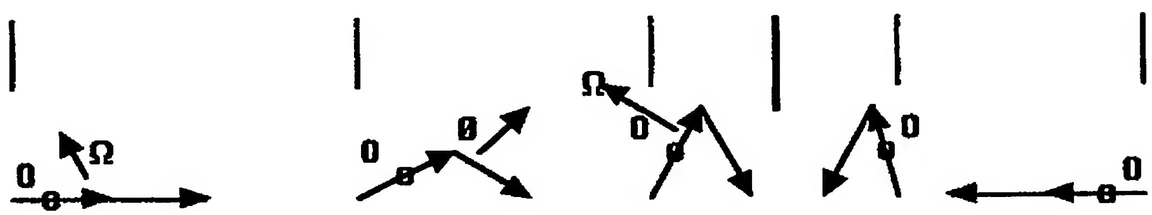
DIAGRAM A4/4

PATENT SPECIFICATION

DIAGRAM A4/5



CAM
(DISK WITH BEARING HOLE 46)



NOTE : THE CRANK PIN RADIUS AND THE CAM RADIUS ARE THE SAME LENGTH . (MODULUS OF LENGTH VECTORS IS THE SAME.)

REF. P4 LINE 24 -26 . QUOTE 'THE CENTER OF CONNECTOR ROTATION WHICH IS CONFINED TO RECIPROCATION IS A DISTANCE OF ONE CRANKPIN RADIUS FROM THE CRANKPIN CENTER .' UNQUOTE

REF. P11 LINE 39 -44 . QUOTE 'BECAUSE THE CRANK CENTER (CENTER OF CRANK ROTATION) 50 AND THE CENTER OF CONNECTOR ROTATION 54 COINCIDE AT MIDSTROKE , THE DISTANCE FROM THE CRANKPIN CENTER 52 TO THE CENTER OF CONNECTOR ROTATION 54 IS EQUAL TO THE DISTANCE FROM CRANK CENTER 50 TO CRANKPIN CENTER 52 AND THUS EQUAL TO THE CRANKPIN OFFSET.' UNQUOTE

NOTE: THE CRANKPIN CENTER AND THE CAM CENTER COINCIDE AT MIDSTROKE .

REF, P11 LINE 39 - 44 . QUOTED ABOVE. ALSO, REF. FIG 5 SHEET 2 OF 4

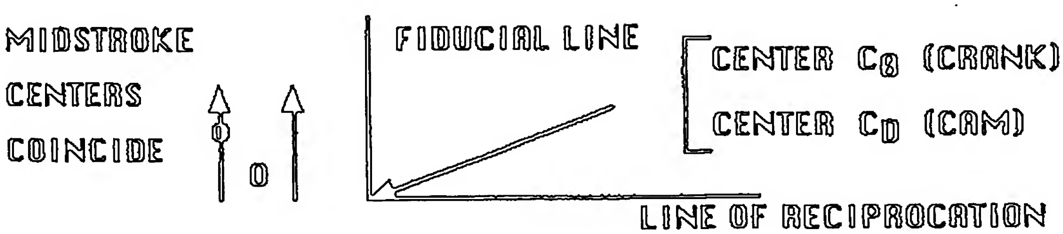


DIAGRAM A4/6

NOTE : BOTH THE CRANK AND THE CAM ROTATE CONTINUOUSLY THROUGH SUCCESSIVE FULL CYCLES , IN OPPOSITE DIRECTIONS OF ROTATION .

REF. P3 LINE 65 – 67 AND P4 LINE 1 AND 2 .

QUOTE ' THE CONNECTOR : (1) INCLUDES CONNECTOR COUNTERWEIGHTS ; (2) HAS A PREDETERMINED SPECIAL SIZE , MASS AND DIMENSION ; (3) ROTATES IN AN ANGULAR DIRECTION OPPOSITE THAT OF THE CRANKSHAFT ; (4) HAS A STROKE FOUR TIMES THE CRANKPIN OFFSET IN AN AXIS OF RECIPROCATION ; . . . ' UNQUOTE

THE JAMMING POINT

THE BASIC OR PRIMARY DEVICE TENDS TO JAM AT MIDSTROKE. NO COMMENT WILL BE MADE ABOUT THE OTHER COMPONENTS OR FUNCTIONS. NO COMMENT WILL BE MADE ON ANTI–JAMMING COMPONENTS

REF. P26 LINE 47–54 QUOTE ' THIS WOULD NOT BE POSSIBLE FOR HIGH RPM APPLICATIONS WITHOUT CONNECTOR COUNTERWEIGHTS DUE TO THE MAGNITUDE OF THE INERTIA FORCES THROUGH MIDSTROKE. IN THESE CASES THE RECIPROCATING MECHANISM WOULD FALL BEHIND THE CRANKPIN AS IT PASSED THROUGH MIDSTROKE RESULTING IN EXCESSIVE FORCES AND FRICTION AS IT CAUGHT BACK UP AFTER MIDSTROKE OR IT MAY EVEN JAM.' UNQUOTE

COMMENT THE ABOVE PROPERTY OF THE PRIMARY OR BASIC UNIT IS A CRITICAL PROBLEM , WHICH IS STATED BY THE PATENTEE - INVENTOR.

NO COMMENT WILL BE MADE ABOUT THE ADDITIONAL COMPONENTS AND FEATURES AND , THE EFFECTS , WHICH MAY DESIGN OUT THIS PROBLEM.

REF. P1 LINE 55 -63 QUOTE 'THE SECONDARY INTERFACE BETWEEN THE CRANK AND THE RECIPROCATING MEMBER DISCLOSED IN U.S. PAT. No. 4,658,768 ISSUED TO DIUGLAS T. CARSON ON APR. 21, 1987 , FOR 'ENGINE' AND THE SECONDARY INTERFACE BETWEEN THE CONNECTOR AND THE HOUSING IS DISCLOSED IN U.S. PAT. No. 4,932,373 ISSUED TO DOUGLAS T. CARSON ON JUN. 12, 1990 , FOR 'MOTION CONVERTING MECHANISM' , THE DISCLOSURE OF WHICH ARE INCORPORATED HEREIN BY REFERENCE ELIMINATE THE SECOND DEGREE OF FREEDOM THROUGH MIDSTROKE.' UNQUOTE

REF. P2 LINE 20 - 34 QUOTE 'THE PRIOR ART MOTION CONVERTING MECHANISM HAVE SEVERAL DISADAVANTAGES , SUCH AS FOR EXAMPLE : (1) ..... (4) THEY REQUIRE ADDITIONAL MOVING COMPONENTS , AS DESCRIBED IN U.S. PAT. NOS. 4,658,768 AND 4,932,373 (SEE ABOVE) , OTHER THAN THE BASIC UNIT CONSISTING OF ONE CRANK ASSEMBLY ONE CONNECTOR AND ONE RECIPROCATING MEMBER TO FULLY BALANCE THE MACHINE.' UNQUOTE

REF. P2 LINE 59 - 65 QUOTE 'IT IS A STILL FURTHER OBJECT OF THE INVENTION TO PROVIDE A MACHINE THAT INCLUDES A RECIPROCATING MEMBER COUPLED TO A ROTARY MEMBER BY A SPECIAL CONNECTOR WITH CONNECTOR COUNTERWEIGHTS AND ALSO INCLUDES AN INTERMITTENT SECONDARY INTERFACE BETWEEN THE CRANK AND THE RECIPROCATING MEMBER TO INSURE CONTINUITY OF RECIPROCATING MEMBER MOVEMENT THROUGH THE CENTER OF EACH STROKE.' UNQUOTE

REF. P8 LINE 57 - 60 QUOTE 'THE CONNECTOR 14 INCORPORATES INTERMITTENT SECONDARY INTERFACES 44A AND 44B TO INSURE CONTINUITY OF RECIPROCATING MEMBER THROUGH THE CENTER OF EACH STROKE AND INCORPORATES COUNTERWEIGHTS 42A AND 42B THAT CAUSE ....' UNQUOTE

REF. P12 LINE 47 - 49 QUOTE 'HOWEVER, AS THE CRANKPIN CENTER 52 APPROACHES MIDSTROKE, THE RELATIONSHIP FOR THE PRIMARY MECHANISM WITH OUT A SECONDARY INTERFACE BECOMES LESS DEFINED.' UNQUOTE

REF. P12 LINE 63 - 68 AND P13 LINE 1 - 15 QUOTE 'BECAUSE OF THIS RELATIONSHIP WHERE THE CHANGE IN THE SINE OF THE ANGLE IS VERY SMALL COMPARED TO THE CHANGE IN THE COSINE OF THE ANGLE, THE CENTER OF CONNECTOR ROTATION 54 SEVERAL COULD EASILY BE SEVERAL DEGREES OR EVEN MORE AHEAD OF OR BEHIND THE CRANKPIN 52 AT MIDSTROKE. FURTHER, (TO P13), SINCE THE SET OF ANGLES WITH SINES ESENTIALLY APPROACHING 1 INCLUDE THE ANGLES FROM ABOUT

85 DEGREES TO 95 DEGREES , THE CENTER OF CONNECTOR ROTATION 54 COULD RUN SUBSTANTIALLY AHEAD OR BEHIND ITS THEORETICAL POSITION RELATIVE TO THE CRANKPIN CENTER 52 ESPECIALLY IF RECIPROCATING MEMBER ASSEMBLY 10 IS SUBJECTED TO LARGE FORCES THAT ARE IN THE DIRECTION OF RECIPROCATION THROUGH THE PORTION OFMIDSTROKE. IN ADDITION, A SECOND DEGREE OF FREEDOM EXISTS AT EXACT MIDSTROKE WHEN THE CENTER OF CONNECTOR ROTATION 54 COINCIDES WITH CRANK CENTER 50 . AT EXACT MIDSTROKE , IT IS POSSIBLE FOR CRANK ASSEMBLY 12 AND CONNECTOR 14 TO ROTATE WITH THE SAME ANGULAR VELOCITY IN THE SAME DIRECTION RESULTING IN ZERO RECIPROCATION MOTION AND VELOCITY FOR THE CENTER OF CONNECTOR ROTATION 54 AND RECIPROCATING MEMBER ASSEMBLY 10 .

A SECONDARY INTERFACE TO AUGMENT THE PRIMARY MECHANISM (CRANK , CRANKPIN , CONNECTOR , ROD ASSEMLY AND HOUSING WALLS) CAN ELIMINATE THE SECOND DEGREE OF FREEDOM AND THE POSSIBILITY OF RECIPROCATING MEMBER RUNNING AHEAD OR FALLING BEHIND ITS THEORETICAL POSITION RELATIVE TO THE CRANK.

U,S, PAT. NOS. 4,658,768, 4,543,919 AND 4,485,769 DESCRIBE A SECONDARY INTERFACE BETWEEN THE CRANK ASSEMBLY AND THE ROD ASSEMBLY AND U.S. PAT. NO. 4,932,373 DESCRIBES A SECONDARY INTERFACE BETWEEN THE CONNECTOR AND THE HOUSING WALLS THE DISCLOSURES OF WHICH ARE INCORPORATED HEREIN BY REFERENCE.' UQ

REF. P14 LINE 50 - 52 QUOTE 'THEY ELIMINATE AN INHERENT WEAKNESS IN THE SIMPLIFIED DESIGN OF THE PRIMARY MECHANISM AND THE SECONDARY INTERFACE WHERE . . . . .' UNQUOTE

COMMENT THE ABOVE STATEMENTS BY THE PATENTEE-INVENTOR SHOW THAT THE PRIMARY OR BASIC UNIT TENDS TO JAM.

COMMENT AT MIDSTROKE IT IS POSSIBLE TO GET A CLOSED VECTOR FORCE TRIANGLE. THERE MAY BE MORE THAN ONE MECHANISM BY WHICH THIS OCCURS , PERHAPS , DEPENDING ON COMPONENT ENGINEERING CLEARANCES.

NO FURTHER COMMENT WILL BE MADE ON MIDSTROKE JAMMING AND NO DETAILED ANALYSES WILL BE MADE.

COMMENT THIS IS PHYSICALLY A THREE VECTOR DEVICE IN MOST PHASES OF THE DYNAMIC MOTION . THE REDUCED TWO VECTOR SET HAS BEEN USED IN THE VECTOR ANALYSIS OF THE MOTION .

\- - - - -

4.23 DEVICE D/ DU & DU

THIS DEVICE CONSISTS, IN PART, OF A YOKE 11 WHICH HAS AN ELLIPTICAL SLOT 14 WITH ITS MINOR AXIS COINCIDENT TO THE CENTRAL LONGITUDINAL AXIS RUNNING THROUGH THE YOKE. INSIDE THE SLOT 14 IS A CIRCULAR CAM 15 CARRIED BY A SHAFT 16.

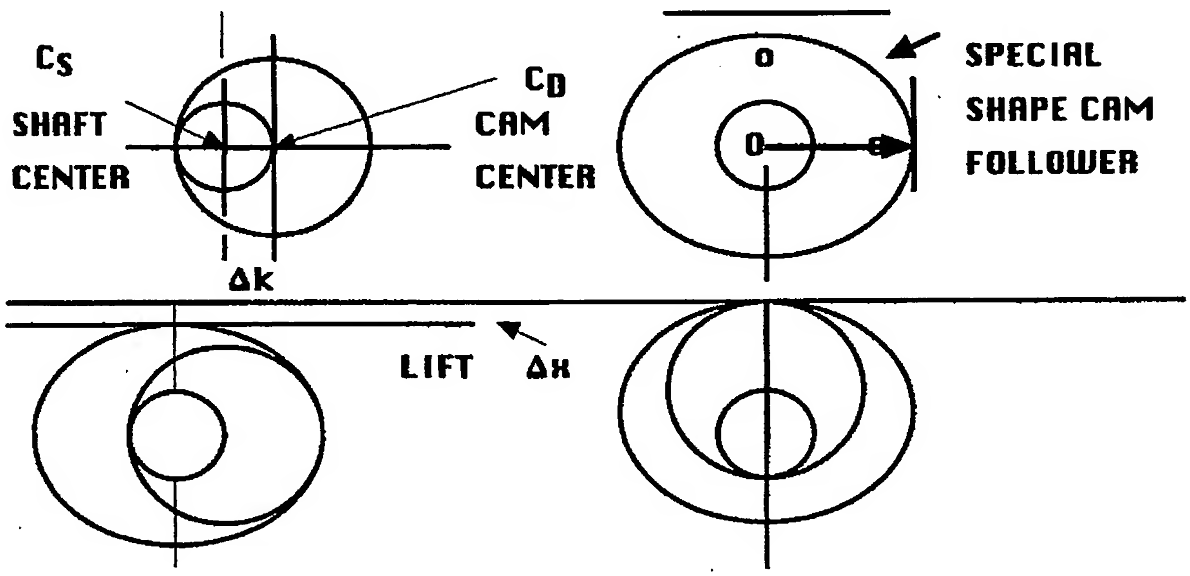


DIAGRAM A4/7

THIS IS A UNIVECTOR DEVICE. THE DIRECTION OF THE FORCE VECTOR VARIES WITH THE ANGLE OF ROTATION. THE VECTOR GIVES SPECIAL LIFT.

– – –

4.3 DEVICE D/GALV

THIS DEVICE CONSISTS OF A SHAFT 4 , TO WHICH IS ATTACHED A TORQUE LOBE 6 , THE SHAFT AND LOBE CONSTITUTE A CAM OR CIRCULAR ECCENTRIC. THE CAM ROTATES IN SIDE A BALL OR ROLLER BEARING WHICH IS INSIDE A DRIVE RING OR YOKE. A CONROD 3 , CONNECTS THIS CAMSHAFT AND BEARING TO A PISTON PIN 2. THE CRANKSHAFT CENTER OR CENTER OF SHAFT 4 , IS OFFSET FROM THE LINE OF RECIPROCATION WHICH PASSES THROUGH THE PISTON PIN CENTER AND IS PAR ALLEL T THE PISTON CYLINDER WALLS.

REF. P4 LINE 16 - 20 QUOTE 'ADVANTAGEOUSLY , THE AXIS OF THE OR EACH PISTON IS OFFSET FROM THE AXIS OF THE OUTPUT SHAFT BY A DISTANCE EQUAL TO SUBSTANTIALLY HALF THE STROKE OF THE ASSOCIATED PISTON.' UNQUOTE

REF. FIG 3A - 3D

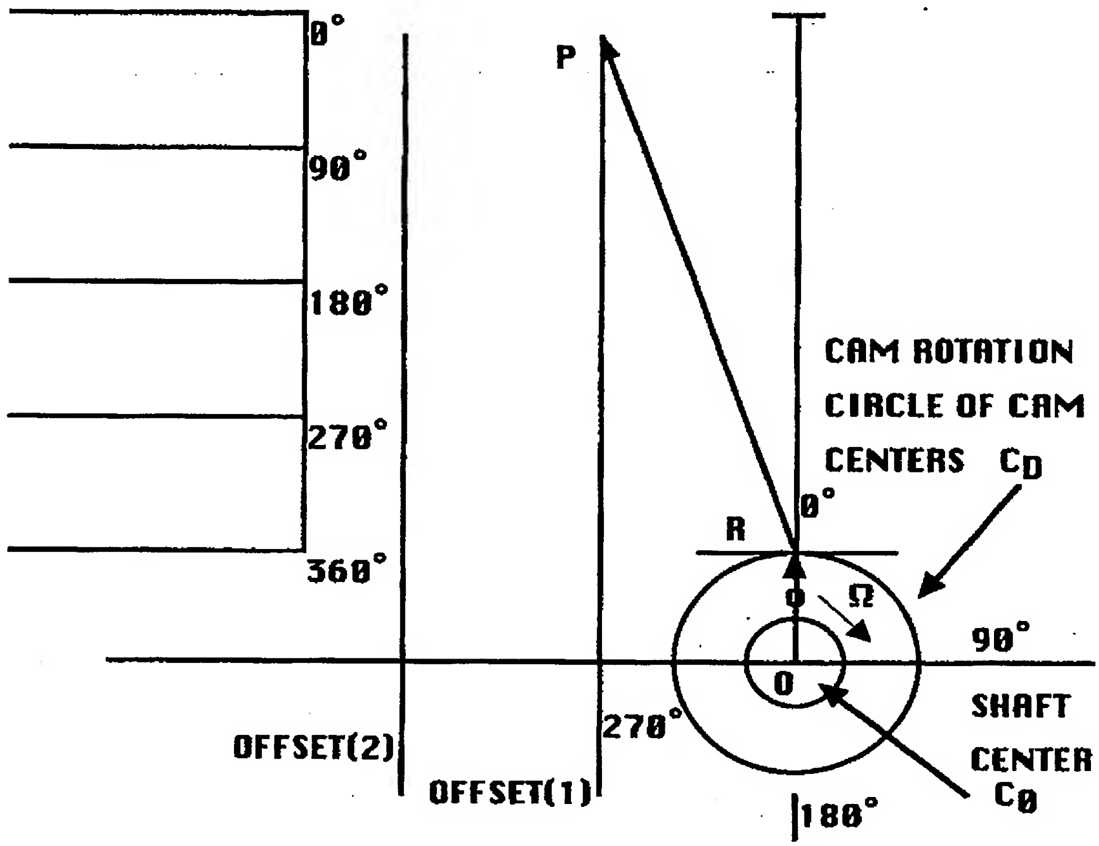


DIAGRAM A4/8

THIS IS A TWO VECTOR DEVICE .

LOCALIZED TORQUE VECTOR OA , WHICH ROTATES ABOUT FIXED POINT O .

UNLOCALIZED FORCE AND LENGTH VECTOR AP .

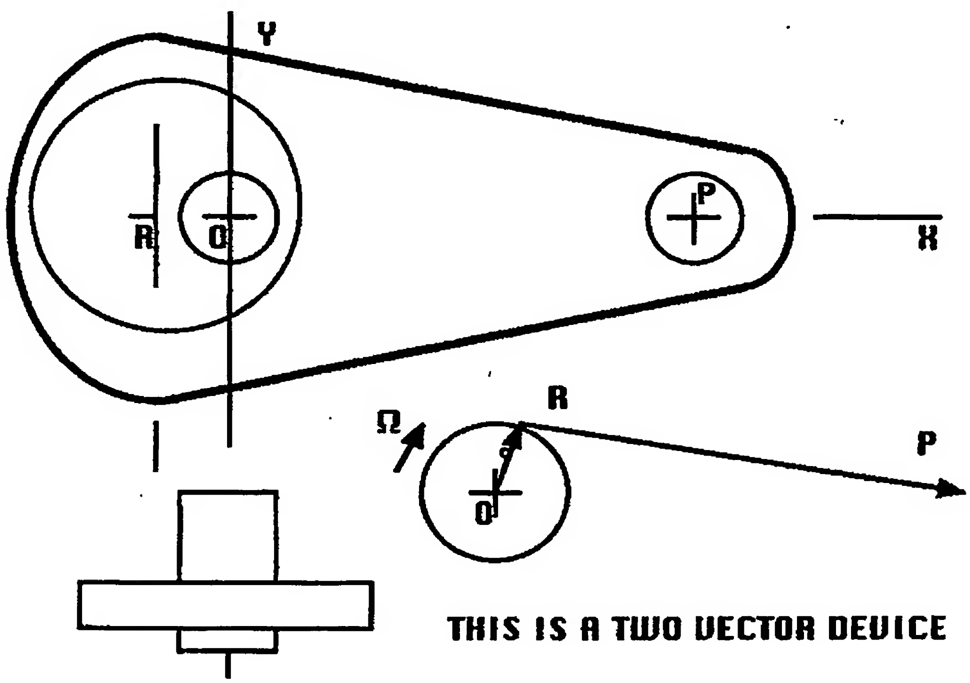
A LARGE OFFSET WOULD PRODUCE A NON SYMMETRIC DISPLACEMENT OF POINT P ALONG THE LINE OF RECIPROCATION.

4.24 DEVICE D/LIEB

THE CRANKSHAFT (A SHAFT) 33 IS RIGIDLY AND ECCENTRICALLY ATTACHED TO BEARING PIN 35 . THE BEARING PIN IS FORMED BY A ROUND , DISC-SHAPED ELEMENT 35 ECCENTRICALLY SECURED ON THE CRANKSHAFT.

THE CRANK 'WEBB' IS ESSENTIALLY AN ECCENTRIC. THE BEARING 32 IS A BALL BAERING.

NO COMMENT IS MADE ABOUT THAT PART OF THE DEVICE BY WHICH THE CONNECTING PIN DRIVES A PAIR OF HORIZONTALLY OPPOSED PISTONS .



THIS IS A TWO VECTOR DEVICE

DIAGRAM A4/9

4.25 DEVICE D/OZDA

THIS DEVICE CONSISTS OF A CRANK WITH THE MAIN SHAFT AT FIXED POSITION 20 , AND A CRANK PIN OR PEG 7 , WHICH IS CONNECTED ROTATABLY AND ECCENTRICALLY TO A DISC , WHICH IN TURN IS CONNECTED ROTATABLY AND ECCENTRICALLY TO A LARGE ECCENTRIC WHICH IS MOUNTED IN THE CONROD BEARING OR YOKE.

NO COMMENT WILL BE MADE ON THE OTHER MECHANISMS

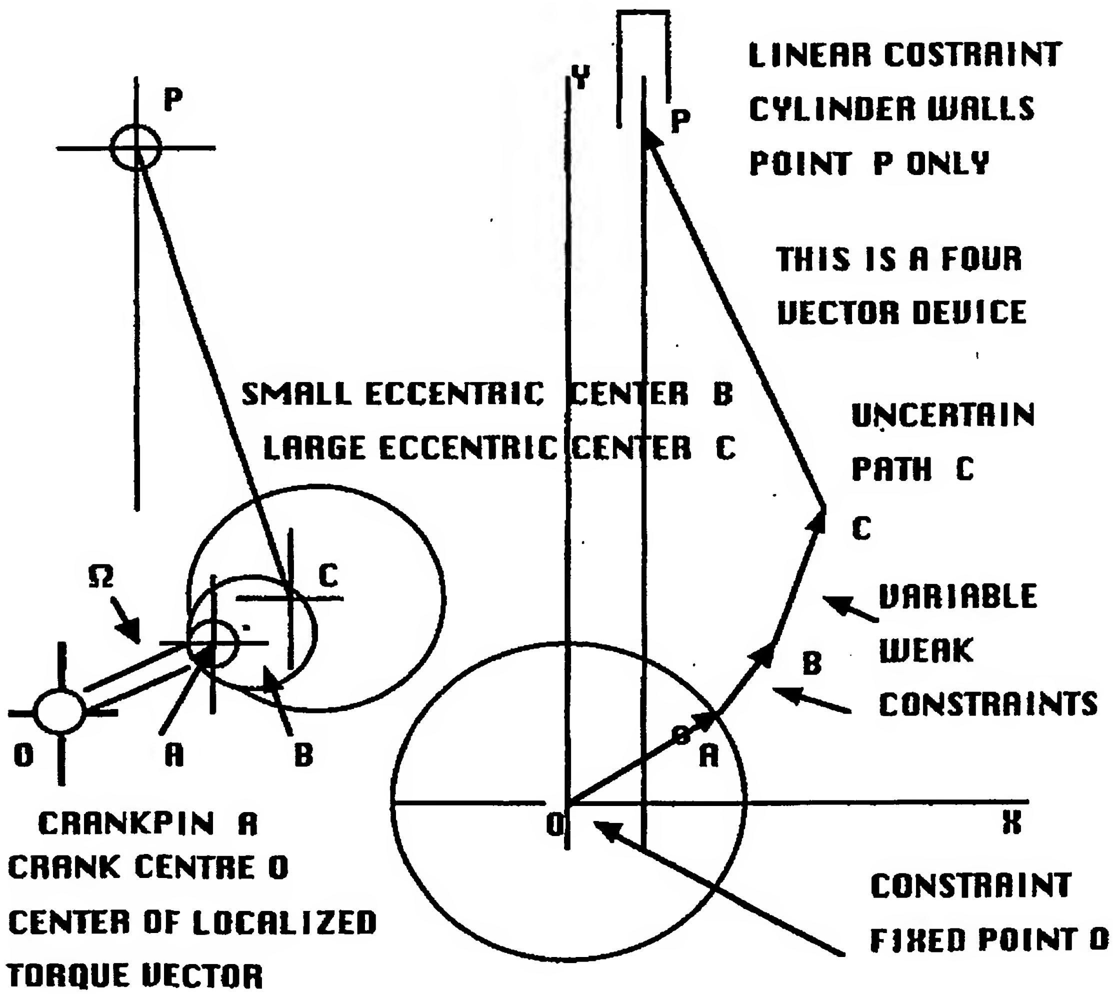


DIAGRAM A4/10

THE MOTION OF THE VECTORS $\overline{AB}$, $\overline{BC}$ COULD BE A VERY WIDE RANGE OF PATHS. EVEN WITH THE ATTACHED MECHANISM THE MOTION DEPENDS AND VARIES WITH SPRING TENSION AND PISTON PRESSURE.

THE PATH SHOWN IN FIG, 2 IS ONLY ONE OF A WHOLE RANGE OF POSSIBLE PATHS OF MOTION.

REF. P 1 LINE 24 -26 QUOTE 'HOWEVER, BOTH ECCENTRIC PIECES IN THE CONNECTION ROD (4) ARE UNDER IMPACT OF THE SPRING , WHICH LEADS TO PROBLEMS DURING THE PRODUCTION PHASE.' UNQUOTE

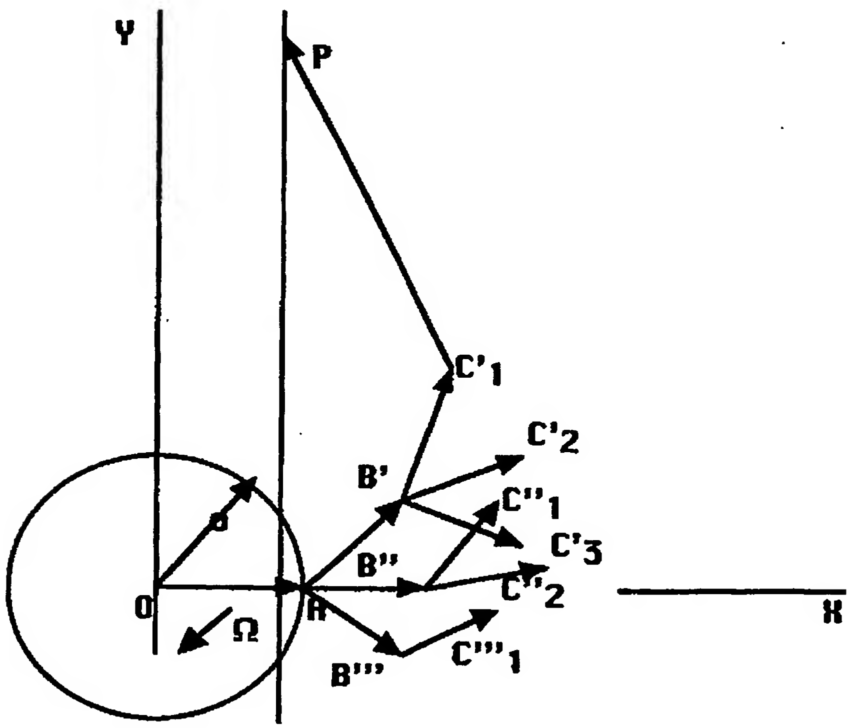


DIAGRAM A4/11

THE DEVICE IS 'UNCONSTRAINED'. THE EXAMPLE GIVES A ROUGHLY CIRCULAR MOTION TO THE BEARING OR YOKE CENTER .
THE FOUR VECTOR SYSTEM , ITSELF , WITHOUT CONSTRAINTS WOULD COLLAPSE TO SOME POSITION DETERMINED BY GRAVITATIONAL FORCES.
THE DEVICE GIVES NO DEFINITE PATH OF MOTION FOR THE CENTER OF THE BEARING AND HENCE POINT P RELATIVE TO THE MOTION OF THE MAIN SHAFT OA . THE SPRING IS AN ESSENTIAL COMPONENT OF THE DEVICE.

4.3 REBUTTALS

4.31 DEVICE D/CARS

THE DIFFERENTIA

D/CARS	D*/PAKEN
1 THE VECTOR CENTERS MUST INITIALLY BOTH BE AT THE MIDSTROKE COMMON CENTER.	1 THE VECTOR CENTERS MUST <u>NOT</u> BOTH BE AT THE ORIGIN (FIDUCIAL LINE AND LINE OF RECIPROCATION
2 THE TWO VECTORS MUST BE THE SAME LENGTH.	2 THE TWO VECTORS MUST <u>NOT</u> BE THE SAME LENGTH.
3 THE DISK ROTATES IN A FULL CIRCLE.	3 THE DISK ROTATES SECTORIALLY AND OSCILATORALLY.
4 THE DISK ROTATES IN THE OPPOSITE DIRECTION TO THE CRANKSHAFT TORQUE VECTOR.	4 THE DISC ROTATES SECTORALLY IN THE SAME DIRECTION AS THE CAM AND THEN SECTORALLY IN THE OPPOSITE DIRECTION TO COMPLETE THE CYCLE.
5 THE DEVICE HAS ONE DOUBLE THROW CYCLE OF DISPLACEMENT WHICH IS SYMMETRIC.	5 THE DEVICE HAS TWO OR MORE CYCLES OF DISPLACEMENT ; ONE IS SYMMETRIC; ONE IS ASSYMMETRIC (OPTIONAL POINT ON CIRCLE OF CENTERS FOR GIVEN DIMENSIONS).
6 THE BASIC UNIT OF THE DEVICE WHICH IS COMPARABLE JAMS AT MIDSTROKE. (COULD BE SUBJECT TO HABEUS MACHINA)	6 THE DEVICE DOES <u>NOT JAM</u> AT ANY POINT IN ANY CYCLE. NO ADDITIONAL MECHANISMS ARE NECESSARY.

HABEUS MACHINA A DEVICE MADE ACCORDING TO THE DESIGN OF D/CARS , WITHOUT THE EXTRA MECHANISMS, UPON WHICH NO COMMENT WILL BE MADE , COULD BE LIABLE TO THE DEFENCE OF 'HABEUS MACHINA' . IF SUCH A DEVICE CANNOT BE PRODUCED WHICH WORKS I.E. WITHOUT JAMMING , THEN IT IS AN 'INVALID DEVICE' FOR MANUFACTURE .

A COMPARISON , WHICH COMPARES A DEVICE WHICH DOES NOT WORK WITH A DEVICE WHICH DOES WORK , ON THIS POINT ALONE, INDICATES THAT THERE EXISTS A SIGNIFICANT DIFFERENCE BETWEEN THE DEVICES .

SUMMARY OF COMPARISON

THE DIFFERENTIAE 1 – 7 SHEW , THAT THE DEVICES ARE NOT :

1. IDENTICAL 2 .SIMILAR 3. CONTIGUOUSLY DERIVATIVE .

4.32 DEVICE D/ DU & DU

THE DIFFERENTIA	D*/PAKEN
1 THIS DEVICE IS A UNIVECTOR DEVICE FUNCTIONING AS A LIFT CAM WITH A SPECIAL CAM FOLLOWER.	1 THIS IS NOT A UNIVECTOR DEVICE .
2 THIS DEVICE HAS A CAM FOLLOWER.	2 THIS DEVICE DOES NOT HAVE A CAM FOLLOWER.
3 THIS DEVICE DOES NOT HAVE A FREELY ROTATING DISK IN A YOKE.	3 THIS DEVICE HAS A FREELY ROTATING DISK IN A YOKE .
4 THERE IS ONE COMPONENT ROTATING	4 THERE ARE TWO COMPONENTS ROTATING AT LEAST SECTORALLY .

SUMMARY OF COMPARISON

THE DIFFERENTIAE 1- 3 SHEW , THAT THE DEVICES ARE NOT :

1. IDENTICAL 2 .SIMILAR 3. CONTIGUOUSLY DERIVATIVE

4.33 DEVICE D/GALV ------

THE DIFFERENTIA	D*/PAKEN
1 THE DEVICE IMPARTS LINEAR MOTION TO A POINT I.E. THE PISTON PIN NOT TO THE CONROD. A PISTON PIN IS NECESSARY .	1 THE DEVICE IMPARTS A LINEAR MOTION TO THE YOKE AND CONROD IF IT IS LINEARLY CONSTRAINED BY PISTON CYLINDER WALLS (THIS CONSTRAINT IS OPTIONAL) .
2 THERE IS ONLY A CAM WITHIN THE BEARING .	2 THERE ARE TWO COMPONENTS WITHIN THE YOKE .
3 THE DYNAMIC MOTION AT THE RECOMMENDED OFFSET IS ONLY SLIGHTLY DIFFERENT TO THAT OF WITH NO OFFSET .	3 THE DYNAMIC MOTION IS SYMMETRIC OR VERY DIFFERENT IN THE ASSYMMETRIC MODE .
4 THIS IS A TWO VECTOR DEVICE .	4 THIS IS PHYSICALLY A THREE VECTOR DEVICE (A REDUCED TWO VECTOR SET CAN DESCRIBE THE VECTOR PATH)

SUMMARY OF COMPARISON

THE DIFFERENTIAE 1- 4 SHEW , THAT THE DEVICES ARE NOT :

1. IDENTICAL
2 .SIMILAR
3. CONTIGUOUSLY DERIVATIVE .

4.4 DEVICE D/LIEB

DIFFERENTIA	D*/PAKEN
1 THE DEVICE IMPARTS LINEAR MOTION TO A POINT I.E. THE PIN NOT TO THE CONROD. A PIN IS NECESSARY . THIS PIN IS CONNECTED TO OTHER MECHANISMS .	1 THE DEVICE IMPARTS A LINEAR MOTION TO THE YOKE AND CONROD IF IT IS LINEARLY CONSTRAINED BY PISTON CYLINDER WALLS (THIS CONSTRAINT IS OPTIONAL) .
2 THE DYNAMIC MOTION IS THE SYMMETRIC MOTION PRODUCED BY AN ECCENTRIC AND CONROD WITH CENTERS IN THE LINE OF RECIPROCATION.	2 THE DYNAMIC MOTION IS SYMMETRIC OR VERY DIFFERENT IN THE ASSYMMETRIC MODE .
3 THERE IS ONLY A CAM WITHIN THE BEARING .	3 THERE ARE TWO COMPONENTS WITHIN THE YOKE .
4 THIS IS A TWO VECTOR DEVICE .	4 THIS IS PHYSICALLY A THREE VECTOR DEVICE (A REDUCED TWO VECTOR SET CAN DESCRIBE THE VECTOR PATH)

SUMMARY OF COMPARISON

THE DIFFERENTIAE 1-4 SHEW , THAT THE DEVICES ARE NOT :

1. IDENTICAL
2. SIMILAR
3. CONTIGUOUSLY DERIVATIVE .

4.5 DEVICE D/OZDA

DIFFERENTIA	D*/PAKEN
1 THE DEVICE IMPARTS A LINEAR MOTION TO A POINT I.E. THE PISTON PIN . A PIN IS NECESSARY.	1 THE DEVICE IMPARTS A LINEAR MOTION TO THE YOKE AND CONROD IF IT IS LINEARLY CONSTRAINED BY PISTON CYLINDER WALLS (THIS CONSTRAINT IS OPTIONAL) .
2 THE DYNAMIC MOTION IS A VARIABLE AND UNCERTAIN DISPLACEMENT PATH .	2 THE DYNAMIC DISPLACEMENT PATH IS RIGIDLY REPEATABLE INDEPENDENT OF LOAD , ONCE THE DIMENSIONS AND MODE HAVE BEEN SELECTED .
3 THE CRANK CONSISTING OF A SHAFT AND CRANK ARM IS EXTERNAL TO THE BEARING.	3 THE CAM IS INTERNAL TO THE YOKE OR BEARING .
4 THIS IS A FOUR VECTOR DEVICE.	4 THIS IS PHYSICALLY A THREE VECTOR DEVICE (A REDUCED TWO VECTOR SET CAN DESCRIBE THE VECTOR PATH)
5 THERE ARE THREE ROTATING COMPONENTS CONNECTED TO THE BEARING .	5 THERE ARE TWO ROTATING COMPONENTS CONNECTED TO THE BEARING .

SUMMARY OF COMPARISON

THE DIFFERENTIAE 1-4 SHEW , THAT THE DEVICES ARE NOT :

1. IDENTICAL

2 .SIMILAR

3. CONTIGUOUSLY DERIVATIVE .

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COMPLETE SPECIFICATION

LAST PAGE

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